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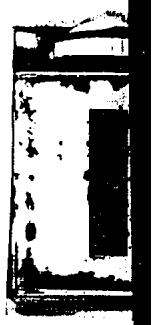


SOURCE As indicated

INFORMATION ON NEW COAL-MINING EQUIPMENT IN USSR

[Numbers in parentheses refer to appended sources.]

Coal Combines

The USSR coal-mining industry has at its disposal machines and mechanisms of the most modern variety. During recent years, over 130 types of new machines for mechanizing labor-consuming mining operations have been developed. The park of principal coal-mining machines is now four times as great as before World War II. Postwar machinery designs have followed radically new trends, and are exemplified by such coal combines as the Donbass, for cutting and loading from seams of moderate thickness; the UKT, UKMG, and Gornyak, for working thin seams; the VOM-2m and the doubled Donbass, for seams of average thickness; the KKP-1 and the UKSh-1 for steep-pitching seams; and the PK-2m, ShBM-17, and PKS, for development work.

Despite the great advances of the past years, the many complex tasks of coal extraction call for more and different machines. The modifications of the Donbass combine illustrate the unremitting efforts of the coal industry to advance mechanization. The regular Donbass combine, originally built to work flat-dipping seams 0,8-1.2 meters thick, has recently been considerably improved: it now can be used on seams up to 1.8 meters thick, and its feed speed has been increased. In coal which is too sticky or too hard, however, the Donbass does not work well. With this in mind, the Donbass-II was built. The motor of the Donbass-II was increased in power from the 65 kilowatts of the regular Donbass to 100 kilowatts, and the force exerted on the feed rope was increased 50 percent. The Donbass-II is equipped with an automatic [feed speed] regulator, improved cutter chain, and bugduster. The Donbass-III, another modification of the combine, works from the frame of a face conveyer, thus sharply reducing loading distance.(1)

In the Mine imeni Kirov of the Leninugol' Trust in the Kuzbass, 70 percent of the coal is extracted by means of the [standard] Donbass combine.(2)

The UKT combine, designed for work in flat-dipping seams 0.45-0.7 meters thick, has been widely used in the Donbass mines. Recently this combine was considerably improved. By reducing the number of revolutions of the rotating bits [mounted on the front end of the machine], the feed was increased 30-40 percent, while required energy expenditure was cut 40 percent. The yield of large coal lumps was increased, and the total yield of coal per cycle was increased 15-28 percent. Dust generation was cut 66 percent.

The K-26 combine [CIA Photo Accession No 150299] mechanizes extraction of sticky and anthracite coal. The extraction element, equipped with powerful cutters, cleaves away the coal in a layer 100-200 millimeters thick. The combine works the entire surface of the face to the full thickness of the seam (up to 1.7 meters), extracting to a depth of 1.5-2 meters. The machine does not require a special track, and at the end of each extraction run, can simply be turned around and run back on another extraction run in the opposite direction. The coal which the K-26 cuts falls onto a transverse loader bar equipped with a scraper, and is fed onto the face conveyer. Affording a productivity of 80 tons per hour, the combine features an automatic feed device.

A new combine [the KS-2], developed by a certain Stazhevskik, is showing up well on tests. Intended for extraction of soft and medium-hard coal, this combine can extract up to 300 tons of coal per shift from a seam 82 meters long.

[Comment: This combine (CIA Photo Accession No 150300) is essentially a vertical-blade coal planer, mounted on a reinforced face conveyer. As the coal is cut away from the face, horizontal jacks, secured at intervals along the conveyer, push it closer to the face. These features are clearly shown in the illustration.]

The cutter element moves along the seam face at a speed of 30 meters per minute; it automatically reverses its direction at the ends of the face. The combine can be controlled from the drift; no one has to be at the face to supervise its operation.

For getting coal out of flat-dipping seams of average thickness, a number of bar-type combines were put out some time ago: the KM-4, KM-5, and KM-6, designed by S. S. Makarov; the doubled Donbass combine; and the modified Donbass combine, fitted with a pivoting, expansible bar, making it suitable for working seams of 2.2 meters thickness. Another such combine, the VOM-2m, is operating with success in a mine of the Moskvougol' combine.

A recent arrival on the scene, the K-14 combine [CIA Photo Accession No 150301] is designed to operate in flat-dipping seams 1.8-3.5 meters thick. This machine embodies many of the latest features evolved from first-hand observations in the mines. The cutter element consists of four front-mounted holders, with cutters rotating in a plane perpendicular to the face. [This system is somewhat similar to that of the K-26]. This disposition of the cutters precludes wear on the bits when they are moving in noncutting positions [as in the case of bits on the after side of a cutter bar, for example]. The feed of the combine along the face, and the adjustment of the cutters to the height of the seam are performed by a hydraulic system, the speed of which may be controlled evenly. The combine operates without a special track, and performs cutting and loading on both the advance and return runs. The operating cycle is semiautomatic. The cutter element is readily adapted to varying seam thicknesses, and is capable of removing coal to a depth of 2 meters along a strip 2.6-3.3 meters broad [i.e., 2.6-3.3 meters measured in the same direction

as seam thickness]. Special supports on the combine support the roof at the face and protect the machine and its operator from falling rock.

Industrial tests of an experimental K-14 demonstrated the effectiveness of the new cutter elements and the feasibility of the hydraulic control system. Productivity for cutting alone is rated at 200 tons per hour, and for full combine operation [cutting and loading], at 120 tons per hour, at an average power input of 23.5 kilowatts. During its tests, the combine registered a productivity per shift of 228 tons, at a machine time coefficient of 0.28.

Designs are now being drawn up for a combine capable of extracting coal from seams 2.6-3.5 meters thick at a cutting depth of 2 meters.

The KKP combine has been used extensively in the Donbass mines in steep-pitching seams 0.8-1.3 meters thick. This machine is still undergoing improvements.

The new K-32 combine (UKSh-1) was designed for use in sharp-dipping seams which are thinner than those worked by the KKP. It differs from earlier combines in that it is easily adjusted to changes in seam thickness. In a single shift, the machine can extract from the face a strip of coal 100 meters long and 1 meter deep. Its productivity per shift ranges between 100 and 120 tons of coal.

The extraction element of the K-32 consists of two steel screw conveyers, set with bits and special wedges. The combine moves from top to bottom, suspended by a safety cable which is unreeled from a winch situated in an upper drift.

Combines of the new type, which have extraction elements operating on the principle of large [lump] shearing require less power in breaking up the coal, and generate less dust. They extract a better variety of coal [with regard to lump size?], and have a wide range of application, from sticky to hard coals. Such combines are also more easily adapted to automatic control.(1)

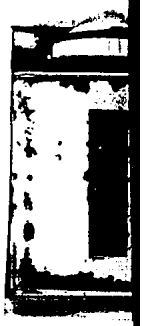
Gornyak Combine

The Gornyak coal combine [redacted] built for use in seams of only 0.6 to 0.8 meters thickness, is equipped with a looped cutter bar and a looped loading bar, which is located behind the former. Both these elements are similar to those on the Donbass combine. The Gornyak, however, does not have a breaker bar. The looped loader is of the scraper-chain type, and is powered by a 35-kilowatt motor, in contrast to the Donbass loading motor of only 13 kilowatts. The controller for the Gornyak loading motor is located in the housing for the main motor.

The feed section of the Gornyak is identical with that of the Donbass. Like the Donbass, the Gornyak has a 65-kilowatt main motor, giving it sufficient power to work hard seams, including anthracite.

Efforts to insure the ruggedness of both the cutter and loader transmissions met with such success that the between-repair service limit of the Gornyak has been set at 12 months, contrasting favorably with the 8-month limit obtaining for the Donbass. Under ideal conditions, this limit should bear extension to 18 months.

Transmission lubrication is of a combined type: a forced system, served by an oil pump equipped with a plastic filter [redacted] supplemented by a splash system. [redacted] of the forced system leading to lubrication points of the cutter-section transmission.]



The first industrial models of the Gornyak, put out by the Gorlovka Plant imeni Kirov in the second half of 1953, had by the end of the year given satisfactory performances at 25 ordinary coal mines and 17 anthracite mines of the Stalinugol' and Vorshilovugol' trusts. The combines managed to provide complete mechanization in extracting and loading coal from seams 0.6-0.85 meters thick. The combine was used successfully on slopes as steep as 45 degrees, although in this case, the loader element was not used, the conditions being ideal for gravity loading.

In the mines of the Stalinugol' Combine, the average productivity of the Gornyak was 4,819 tons of coal per month. At the Voroshilovgradugol' Trust, it was 4,145 tons per month.(3)

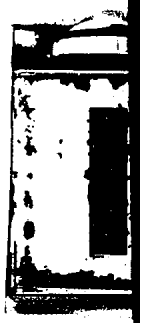
KS-2 Combine

The KS-2 combine, built at the Anzhero-Sudzhensk Svet Shakhtera Plant, underwent tests during 1953 in a mine of the Leninugol' Trust. Designed by Stazhevskikh, in fulfillment of a project of the Kuznetskiy Affiliate of Giprouglemash (State Planning and Designing Experimental Institute for Coal Machinery), the combine is intended for use in extracting and loading coal in flat-dipping seams 0.9-2 meters thick.

The cutter element of the KS-2 combine, called the shuttle, consists of a carriage mounting a vertical planer which is set with a line of small cutters on its leading edge. The shuttle runs on the frame of a scraper conveyer, which constitutes the second element of the combine. This conveyer is laid out along the mine face, and is advanced toward it by a series of horizontal jacks. The third element of the combine is the winch, which pulls the shuttle back and forth along the conveyer. The winch is secured in an upper drift, and the conveyer extends from this drift to a lower one, at the other end of the seam face.

Specifications of the KS-2 are as follows:

Average speed of shuttle	0.52 m/sec
Depth of planing action	100 mm
Height of shuttle	1,240 mm
Width of shuttle	492 mm
Length of shuttle	3,100 mm
Weight of shuttle	1,410 kg
Productivity of conveyer	120 t/hr
Speed of scraper chain	0.9 m/sec
Width of conveyer trough	396 mm
Length of conveyer	84 m
Number of conveyer sections	53
Electric motor of conveyer, type	MA-144-1/4
Capacity of motor, at 1,500 rpm	21.5 kw
Spacing intervals of jacks along conveyer	7.5 m



One-step advance distance of jacks	100 mm
Electric motor of shuttle winch, type	MA-146-1/4
Capacity of winch motor, at 1,500 rpm	68 kw
Diameter of winch drum	430 mm
Rope capacity of drum	170 m
Average rope speed	1.04 m/sec
Tension on rope	7,500 kg
Dimensions of winch	
Height	912 mm
Width	1,440 mm
Length	4,500 mm
Weight of winch	6,500 kg
Over-all weight of combine, with conveyer extended 84 meters	43.5 t

During the 5-month testing period, the KS-2 extracted 28,000 tons of coal, and advanced the seam face [which would be about 84 meters long] a distance of 187 meters. The average monthly production rate, at one working shift per day, was 5,470 tons; the maximum was 5,990 tons. This productivity can be considered high when compared to that of the Donbass. Working neighboring faces of the same seam, Donbass combines were producing 6,000 to 6,500 tons of coal a month, while operating two to three shifts a day. Output of the KS-2 for one hour's actual operating time amounted to 70-80 tons. During some shifts, the combine extracted up to 300 tons of coal and advanced the face a distance of 2 meters.

The tests revealed a number of shortcomings in the design of the KS-2. Because of the closed construction of the conveyer, it is difficult to move timber along the face. While the combine is operating, delivery of timber is impossible, because the tow rope for the shuttle's idle run lies out along the conveyer [in the way]. On faces where the coal of above-average hardness, the combine does not operate very effectively: the shuttle and conveyer are pressed outward, and raised to the roof of the working. The cross-section of the conveyer is not sufficiently large to accommodate the passage of large coal lumps (400 x 400 x 400), which causes stoppages. The shuttle rope is subjected to considerable wear as it passes through the blocks and around the winch drum. The tractive force of the winch is not sufficient to move the shuttle without the use of a block and tackle.

Because of these shortcomings, the combine could not be in operation for more than one shift per day. The performance indexes of the machine should improve considerably with the elimination of its design defects, and with the use of metal supports, including roofing beams, chocks, and organ-type units.(2)

Development Combines and Loaders

Present requirements in the development aspects of underground mining call for improvement of existing rock loaders, coal loaders, and development combines, as well as production of new development combines. Many Soviet coal loaders have already been subjected to considerable modifications. The S-153 coal loader is being replaced by the smaller and more efficient GNL-50. The UPM-1 loader is giving way to the PPM-2, which weighs the same, but affords a 4-meter instead of a 3-meter loading front, and is easier to operate.

The NK-1 combine was built for work in cutting at the face along flat-dipping seams, and for making crosscuts. The PKS-1 was brought out for cutting multiple-strata and stepped drifts of trapezoidal cross section in cases where the coal is to be extracted from sharp-dipping seams. The cutting elements of these combines [presumably the two machines just mentioned] are designed for large [lump] shearing (chips 60-120 millimeters thick): each cutter has three bits, held in spoke-like holders and rotated around a central axis. On the NK-1 these cutters are set in a horizontal plane [presumably, the axis is on a horizontal plane]; on the PKS-1, the cutters are set on an incline. [CIA Photo Accession No 150303 shows the cutter element of the PKS-1 equipped with three of these cutters, set one below the other, with overlapping reach.]

Both the NK-1 and PKS-1 have hydraulic transmission. The working cycle for both machines is performed semiautomatically. The NK-1 keeps dust from getting into the air around it by the action of a device which sucks away the dust as it forms, and moves it into a special precipitator. The average shift productivity of the NK-1 amounts to 12 running meters' extraction for a drift 3 meters wide and 0.8-1.6 meters high. The PKS-1 affords an advance of 10-12 meters per shift. Both the NK-1 and the PKS-1 can handle coal of any hardness or adhesiveness.

The ShBM-1u has been used with success in cutting passages through coal and rock of a 4 to 5 hardness index on the Protod'yakonov Scale.

The PPK-2 development combine was built to penetrate hard rock, having a Protod'yakonov hardness index of from 5 to 12. This combine cuts its way through the rock with a rotary milling unit, and washes the cuttings from the face to the mine surface by means of a hydraulic system. This obviates the need for conveyers and hoists. The PPK-2 represents a marked improvement over its predecessor [the PPK-1]: the milling unit is better, and the machine can change course in a vertical plane. An experimental model of the combine advanced a [rock] face 3.6 meters in one shift. Two PPK-2 combines are now undergoing mine tests.

The PMU-1 rock loader was designed to solve some of the problems presented by inclined development workings. This machine can load rock or coal onto a conveyer or mine car in inclined workings dipping as much as 25 degrees, operating at either coal, rock, or combined coal and rock faces. Two large gathering arms on the loading head move the rock onto a slat conveyer. The loader runs on wheels. It has two manipulators for mounting drilling equipment.

An experimental model of the PMU-1 has successfully sustained mine tests, making a 4.5-meter advance on the incline during a single shift. For a whole month, the advance was 90 meters. A group of PMU-1 loaders has already been produced during these first months of 1953.(1)

MVGA Coal Cutter

The experimental MVGA coal cutter [redacted] built to cut coal of any hardness in inclined [redacted] up to 0.8 meters thick, has a cutter section, bar, electric motor, and bugduster which are identical with those of the MV-60 coal cutter. The MVGA feed section, designed by Giprouglemash (State Planning and Designing Experimental Institute for Coal Machinery) and built by the Malakhovskiy Experimental Plant, [location not given] automatically changes its feed speed in proportion to the load placed on the electric motor. Transmission from the motor to the feed section is hydraulic. The feed section is basically that of the MV-60 machine, except for its hydraulic transmission, automatic feed-speed regulator, and a special ratchet mechanism.

Specifications of the MVGA are as follows:

Electric motor, MAD 191/11 type	
Hourly capacity	57 kw
Continuous capacity	32 kw
Maximum shaft moment	72 kg-m
Cutting speed	1.9 m/sec
Length of bar	2 m
Kerf thickness	120-140 mm
Feed speed	0-1.2 m/mm
Tramming speed	14.5 m/mm
Tension on rope	
Working	7,000 kg
Tramming	4,000 kg
Maximum	10,000 kg
Rope diameter	15-17 mm
Capacity of rope drum	30 m
Productivity of pump	41 liters/min
Volume of oil reservoir	40 liters
Working pressure, hydraulic system	65-100 atm
Over-all length	3,100 mm
Width	740 mm
Height, including oil reservoir [which is located on top of machine]	600 mm
Weight	3,600 kg

The atomatic feed regulation device utilizes the slip changes of the main motor, which is of the induction type. By means of a differential, this motor is geared to the oil pump, together with a small auxiliary electric motor, which operates at a constant speed. When the load on the main motor increases, the productivity of the pump decreases. Since the pump powers the hydraulic feed transmission, the feed speed decreases also. Thus, the heavier the cutting load becomes, the slower the machine advances.

The MVGA presents a number of advantages over cutting machines having standard feed devices. Electric power, for one thing, is utilized more efficiently, and the chance of breakdown as a result of overloading is practically obviated. The machine has been subjected to a series of industrial tests, during which it operated on both automatic and hand-controlled feed systems.(2)

Conveyers

Increased application of coal combines has created a need for new conveyers of increased capacities. Scraper and belt conveyers of various kinds have received broad application. The new conveyers embody radical departures from the designs of former models.

Three new conveyers, the SKR-17, the SK-30m, and the SKM-2, all designed to serve the Donbass combine, have been turned out in experimental groups. The single-chain SKR-17 scraper conveyer, adaptable for use with the combine at seams of over 0.8 meters thick, moves 100 tons per hour at a transport length of 150-170 meters. A single SKR-17 does the work of two SKR-11 conveyers. Its drive, trough, and take-up device are of completely new design.

The SK-30m has a productivity of 120 tons per hour at a transport distance of 200 meters. Its set of troughs weighs one half the set of the SKR-30 conveyer. Its tension mechanism is hydraulically operated.

The SKM-2 can move coal from the face a distance of 250 meters, operating either with a combine or a cutter running on the conveyer frame. It is moved toward the face, when required, by mechanical jacks, and does not have to be taken apart for this. The conveyer has both head and tail-section drives, and sometimes a third drive. Each drive features a hydraulic transmission. Thus, the chain is subjected to more uniform tensions, and starting is smoother.

Belt conveyers of present design can be used only in straight workings, while the maximum length of a single-drive model does not exceed 300 meters. The new KZL-110 conveyer, however, affords transportation along curved drifts, and along greater distances. Tension is not exerted through the belt itself, but through a scraper chain. [The scraper chain, [redacted] is attached to flights whose ends run in grooves at the sides of the conveyer frame. The belt is secured to these flights.] The KZL-110 can afford continuous transport of up to 1,000 meters.

In answer to the need for conveyers giving high productivity over great distances, a cable-reinforced belt, capable of sustaining a tension of 165 tons, has been developed. This belt is good for a continuous layout of 600 meters. The belt, rigged on a suitably powered conveyer, has held up well under tests. Productivity was rated at 350 tons per hour.

A chain conveyer has been developed especially for operation in the Podmoskovniy coal mines. It is able to move coal through angles in a vertical plane.

Many improvements have been incorporated into the construction of recent scraper conveyers. Introduction of wear-resistant strips in the trough sections should save 3,000 tons of metal a year. Improvement in chain manufacture has cut the incidence of parting 35 percent.

Conveyer service is being extended not only at mine faces, but in all underground mining areas, so as to afford a connected system from face to shaft, and even to the surface.(1)

Props

The advent of the many new machines at the mines created a need for correspondingly advanced devices for propping, both at the face, and in development passages. In recent years, there has been a large-scale trend toward use of metal and reinforced-concrete props. Today, metal props are used at over 700 mine faces; while there are 1,150 kilometers of metal frames and 460 kilometers of reinforced-concrete props in development workings.

The SGK-2 cotter-lock mine prop (now the M-1), and the SDT prop, which was designed by DonUGI (Donets Scientific Research Coal Institute), have been used extensively. Recently both these props were lightened without impairing their strength. Depending on its type-size, the SGK prop was reduced in weight 8-28 kilograms, or 40 percent in each case. Metal props are also used for thin seams. Hinged metal roof beams have been used with success for thin, dipping seams, where roof support over the conveyer is required. These beams have practically eliminated the need for wooden timbers at the face.

Metal organ-type supports are now being used for support purposes. The MOS type wall section has been successfully applied as a cutter-support in some mines for several years. The screw type OK-150 support is now in use, handling roofing operations in seams exceeding 0.45 meters in thickness, and dipping as much as 25 degrees. Use of the organ-type support will be expanded in the near future. Loading and moving of these devices are being mechanized, with remote control for these operations planned. Mechanized moving of the organ type support will render roofing operations much safer, and sharply reduce nonproductive operations at the mine face. [CIA Photo Accession No 150304 shows the MOK-1 organ type support to consist essentially of a broad base presenting an inclined side, up which an upper member, having a broad flat top, can be moved to the desired roofing height.]

Metal props and MOS organ-type supports do not now mechanize the process of propping and roofing at the coal-yielding face. Recently, several types of mechanized mine supports have been developed: the MPK, the ShCh-50, and the KSM. The mobile MPK support, used in combination with the Donbass combine and a flexible scraper conveyer, has registered satisfactory performance in one of the mines of the Donbass. An improved version of the MPK is now being built.

The mobile shield-type ShCh-50 support has undergone tests in the Podmoskovniy coal fields, working with a scraper conveyer in the extraction of coal by blasting.

For use in sharp-dipping seams of the Donbass coal mines, a so-called swinging (mayatnikovyy), self-propelled support device, intended for use with combines, has been developed. This device consists of two [complex] metal props connected by chains, forming a system of frames. These frames, suspended by the chains, move under their own weight, as a pendulum, [down] along the [sharp-dipping] seam. The device thus provides rapid support for the areas dug out by the combine.

It can be seen from the above, that the current trend is toward mechanization by means of entire complexes of machinery, including combines, conveyers, and support devices, all designed to work as an aggregate. Remote control, whereever it can be applied, receives prime consideration.(1)

Mechanization of mine propping has virtually only begun, and in most places where it is being applied is still in the experimental stage. Current efforts at complex mining mechanization place heavy emphasis on development of props which will be able to serve the Donbass combine and its ancillary machinery in work at the face.(2)

[The following table surveys recent developments in mine support devices. It represents coverage of all models mentioned in the source article, and gives design characteristics and present status of development in all cases where the article has reported them.]

Developments in Support Devices (2)

Model, Type, and Design	Purpose for Which Built, and Present Status
SGK-2 metal prop SDT " " M(SGK-49) " "	For use in flat-dipping thin seams; now being used to support workings in about 800 mines
MOS organ-type support [CIA Photo Accession No 150311]	
OK organ-type support [CIA Photo Accession No 150311]	
CG-50 [metal] prop SPS " " TS " " ST " "	Undergoing final tests
KShV pivoted roof support; of forged and welded construction.	A group has been produced for industrial use
MPK mechanized support; moved by machine.	For use with Donbass combine; now being tested
DRK [metal] prop DRK-U " "	For flat-dipping seams of average thickness; a group is in industrial use
ShCh-50 shield-type support. [CIA Photo Accession No 150312]; designed by Siglin and Giller	A group is undergoing industrial tests
KSM-1 aggregate prop; consists of two elements, one near the face, the other set back from it.	To be used with the K-14 combine in seams 1.8-3.5 meters thick
PKK mobile face support, of pendulum action	For use with KKP-1 combine; undergoing industrial tests
PSK-2u suspended protection support	For sharp dipping seams; in trail industrial use

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Model, Type, and Design	Purpose for Which Built, and Present Status
MZL shield; features hydraulic feed [CIA Photo Accession No 150313]	For work in inclined shafts
VUGI rack	For use in cutting shafts where frequent cementing is required; being tested
KShZ hydraulically operated prop [CIA Photo Accession No 150314]	For sharp-dipping seams up to 10 meters thick; undergoing tests
KuzNII mechanization support	
KPK-3 [metal] prop KPK-3M " " KPK-L " "	For same conditions as KShZ
M9 [metal] prop	Used extensively in Podmoskovniy basin, in seams where rock sides are weak.
M10 moving device	For use at extraction face
	Used in conjunction with M9, [to move it]

SOURCES

1. Moscow, Mekhanizatsiya Trudoyemkikh i Tyazhelykh Rabot, Jun 1953

2. Ibid., Dec 1953

3. Moscow, Master Uglya, Aug 1954

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